WE CLAIM:

1. A process for optimizing the excitation waveform that is delivered to an ultrasonic transmitter that, together with an ultrasonic receiver, form part of a nonlinear ultrasonic transmission and reception system comprising:

delivering a transmission test signal to the ultrasonic transmitter;

generating a received test signal from the ultrasonic receiver that is a nonlinear function of the transmission test signal;

developing a nonlinear model of the nonlinear function from the transmission test signal and the received test signal; and

determining an optimum excitation signal for the ultrasonic transmitter that substantially maximizes the signal generated by the ultrasonic receiver based on the model and based on a specified constraint on the excitation signal.

2. The process of Claim 1 wherein developing the nonlinear model includes determining kernel functions of the nonlinear function.

3. The process of Claim 2 wherein an algorithm is used in determining the kernel functions.

4. The process of Claim 2 wherein developing the nonlinear model includes determining principal dynamic modes of the nonlinear function based on the kernel functions.

5. The process of Claim 4 wherein determining an optimum excitation signal includes calculating the time inversion of one or more of the principal dynamic modes.

6. The process of Claim 5 wherein one or more of the kernel functions are excluded when calculating the time inversion.

7. The process of Claim 1 wherein developing the nonlinear model includes determining principal dynamic modes of the nonlinear function.

8. The process of Claim 1 wherein a Laguerre-Volterra network is used in developing the nonlinear model.

9. The process of Claim 8 wherein parameters of the Laguerre-Volterra network are adjusted to minimize the mean-squared error between the signal predicted by the network and the received test signal.

10. The process of Claim 9 wherein the adjustment is an iterative process.

11. The process of Claim 1 wherein the nonlinear model includes a linear filter followed by a static nonlinearity.

12. The process of Claim 1 wherein the specified constraint on the excitation signal includes a constraint on the amplitude of the excitation signal.

13. The process of Claim 1 wherein the specified constraint on the excitation signal includes a constraint on the power of the excitation signal

14. The process of Claim 1 wherein determining an optimum excitation signal maximizes the amplitude of the signal generated by the ultrasonic receiver.

15. The process of Claim 1 wherein determining an optimum excitation maximizes the power of the signal generated by the ultrasonic receiver.

16. The process of Claim 1 wherein the transmission test signal is a wideband signal.

17. The process of Claim 16 wherein the wideband signal covers the bandwidth over which the transmission and reception system is configured to operate.

18. The process of Claim 16 wherein the wideband signal is white noise.

19. The process of Claim 16 wherein the wideband signal is a chirp.

20. The process of Claim 1 wherein the transmission test signal covers a dynamic range.

21. The process of Claim 20 wherein the dynamic range is the dynamic range over which the transmission and reception system is configured to operate.

22. The process of Claim 1 further comprising exciting the ultrasonic transmitter with the optimum excitation signal.

23. The process of Claim 22 wherein a breast is placed between the ultrasonic transmitter and the ultrasonic receiver while exciting the ultrasonic transmitter with the optimum excitation signal.

24. The process of Claim 23 wherein the signal received by the ultrasonic receiver in response to the optimum excitation signal is analyzed to create an image of the breast.

25. An ultrasonic imaging system for generating an image of tissue comprising:

an ultrasonic transmitter that converts an excitation signal into an ultrasonic signal;

an ultrasonic receiver positioned to receive the ultrasonic signal transmitted by the ultrasonic transmitter and that generates a received signal that is a nonlinear function of the excitation signal;

an excitation signal generator in communication with the ultrasonic transmitter that generates an excitation signal that substantially maximizes the signal generated by the ultrasonic receiver based on a specified constraint on the excitation signal; and

a processing system in communication with the ultrasonic receiver for processing the signal generated by the ultrasonic receiver into an image of tissue disposed between the ultrasonic transmitter and ultrasonic receiver.

26. The system of Claim 25 wherein the signal generated by the excitation signal generator is derived from a nonlinear model of the nonlinear function.

27. The system of Claim 26 wherein the nonlinear model is developed from a comparison of a transmitted test signal transmitted by the ultrasonic transmitter and a received test signal generated by the ultrasonic receiver.

28. A process for optimizing the excitation waveform that is delivered to a transmitter that, together with a receiver, form part of a nonlinear transmission and reception system comprising:

delivering a transmission test signal to the transmitter;

generating a received test signal from the receiver that is a nonlinear function of the transmission test signal;

developing a nonlinear model of the nonlinear function from the transmission test signal and the received test signal; and

determining an optimum excitation signal for the transmitter that substantially maximizes the signal generated by the receiver based on the model and based on a specified constraint on the excitation signal.

29. A nonlinear transmission and reception system comprising:

a transmitter that converts an excitation signal into a transmitted signal;

a receiver positioned to receive the transmitted signal and that generates a received signal that is a nonlinear function of the excitation signal; and

an excitation signal generator in communication with the transmitter that generates an excitation signal that substantially maximizes the signal generated by the ultrasonic receiver based on a specified constraint on the excitation signal.

30. The system of Claim 29 wherein the signal generated by the excitation signal generator is derived from a nonlinear model of the nonlinear function.

31. The system of Claim 30 wherein the nonlinear model is developed from a comparison of a transmitted test signal transmitted by the transmitter and a received test signal generated by the receiver.